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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/025,144	12/18/2001	Yongsik Moon	AMAT/5803/CMP/CMP/RKK	5051

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APPLIED MATERIALS, INC.
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EXAMINER

SMOOT, STEPHEN W

ART UNIT	PAPER NUMBER
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2813

DATE MAILED: 03/12/2003

129

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/025,144

Applicant(s)

MOON ET AL.

Examiner

Stephen W. Smoot

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 December 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-34 is/are pending in the application.
- 4a) Of the above claim(s) 33 and 34 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 21-23, 25, 26 and 28 is/are allowed.
- 6) ☒ Claim(s) 1-7, 12-14, 24 and 29-32 is/are rejected.
- 7) ☒ Claim(s) 8-11, 15-20 and 27 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 18 December 2001 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 4, 7.
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

This Office action is in response to application papers filed on 18 December 2001 and to applicant's election filed on 27 January 2003.

Election/Restrictions

1. Applicant's election with traverse of Group I, claims 1-32 in Paper No. 8 is acknowledged.

The traversal is on the grounds that the restriction requirement is improper in that the non-elected claims are drawn to an apparatus with a computer based controller that is apparently the only type of apparatus capable of performing the method set forth in claim 29. This is not found persuasive because the elected claims 1-32 are silent regarding the use of a computer based controller. The applicant further argues that support was not provided in showing that the two inventions are distinct, when in fact the requirement per MPEP section 806.05(e) is for the examiner to provide a reasonable example. The examiner contends that the as-claimed methods can be performed without the use of computer control. For example, adjusting the speeds of polishing platens by having a human being turn a knob seems to be one reasonable alternative. The applicant still further argues that the search of both inventions would

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not be burdensome, when in fact it was demonstrated in the restriction requirement that both inventions have a separate status in the art as shown by their different classification.

The requirement is still deemed proper and is therefore made FINAL.

2. Claims 33-34 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected invention, there being no allowable generic or linking claim. Applicant timely traversed the restriction (election) requirement in Paper No. 8.

Information Disclosure Statement

3. All references cited in the information disclosure statements (IDS) received on 13 June 2002 (Paper No. 4) and on 30 January 2003 (Paper No. 7) have been considered by the examiner. The lined through citations are duplicate entries.

Drawings

4. Figure 1 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated (see paragraphs [0010] and [0011]). See MPEP § 608.02(g). A proposed drawing correction or corrected drawings are required in reply

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to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

5. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference signs not mentioned in the description:

150a in Fig. 2;

150b in Fig. 2;

114 in Fig. 3; and

350 in Fig. 5.

A proposed drawing correction, corrected drawings, or amendment to the specification to add the reference signs in the description, are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

6. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference signs mentioned in the description: 106 and 102 (see paragraph [0047], line 5 and paragraph [0048], line 6). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

7. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

8. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

The following title is suggested: Method for Polishing Substrates Comprising Conductive and Low K Dielectric Materials with Reduced Substrate Surface Damage and Delamination.

9. The use of trademarks (e.g. MIRRA, MESA, REFLEXION, POLITEX, SUBA, BLOK, BLACK DIAMOND, ELECTRA CLEAN, ELECTRAPOLISH) has been noted in this application. It should be capitalized wherever it appears and be accompanied by the generic terminology.

Although the use of trademarks is permissible in patent applications, the proprietary nature of the marks should be respected and every effort made to prevent their use in any manner which might adversely affect their validity as trademarks.

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10. The disclosure is objected to because of the following informalities:

Update paragraph [0031] to indicate that 09/244,456 is now 6,244,935;

In paragraph [0038], line 1, change "hard" to --soft--;

Update paragraph [0041] to indicate that 09/244,456 is now 6,244,935;

Update paragraph [0049] to indicate that 08/861,260 is now 6,183,354;

Update paragraph [0049] to indicate that 09/258,042 is now 6,276,998;

In paragraph [0073], recheck validity of 09/469,708 since the issued patent (6,199,933) does not appear to be pertinent to applicant's disclosure;

Update paragraph [0073] to indicate that 09/741,538 has been published as US 2001/0004538;

In paragraph [0110], line 1, change "Table 3" to --Table 2--; and

In paragraph [0110], line 6, change "Table 3" to --Table 2--.

Appropriate correction is required.

Claim Objections

11. Claims 10, 15, 16, 19, 27 are objected to because of the following informalities:

In claim 10, line 1, change the dependency from "claim 10" to --claim 9--;

In claim 15, line 15, change "the carrier" to --a carrier--;

In claim 15, line 16, change "the platen" to --a platen--;

In claim 16, line 2, change "a platen" to --the platen--;

In claim 16, line 3, change "a carrier" to --the carrier--;

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In claim 19, line 2, change "a membrane" to --the membrane--; and

In claim 27, line 2, change "grater" to --greater--.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

12. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

13. Claim 24 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 24 does not particularly point out if the "platen rotational speed" is with regards to the first, the second, or both the first and second platen rotational speeds claimed in claim 21.

Claim Rejections - 35 USC § 102

14. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

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A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

15. Claims 1-6 are rejected under 35 U.S.C. 102(e) as being anticipated by Tran et al.

Tran et al. disclose a method for polishing substrates comprising a silicon oxide layer and at least one metal layer that can preferably be copper with a tantalum or tantalum nitride barrier layer (see paragraph [0028]). The substrates are 200 mm wafers (see paragraph [0031]). During a ramp up phase 3, in which a wafer is brought into contact with a polishing pad, the retaining ring pressure is 4 psi, the membrane pressure is 2 psi, the platen is rotated at 131 rpm, and the wafer carrier is rotated at 129 rpm (i.e. about the same rotational speed as the platen) (see paragraphs [0032] and [0033]).

These are all of the limitations set forth in claims 1-6 of the applicant's invention.

16. Claims 1-4, 6 are rejected under 35 U.S.C. 102(e) as being anticipated by Kollodge et al.

Kollodge et al. disclose a polishing method for removing copper from eight inch diameter wafers that includes a retaining ring pressure of 3.5 psi, a membrane pressure of 3.0 psi, the platen is rotated at 41 rpm, and the wafer carrier is rotated at 39 rpm (i.e.

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about the same rotational speed as the platen) (see paragraphs [0045], [0122], and Table 1).

These are all of the limitations set forth in claims 1-4, 6 of the applicant's invention.

Claim Rejections - 35 USC § 103

17. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

18. Claims 1-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Messner et al.

Messner et al. disclose a method for polishing 200 mm (i.e. eight inch) diameter wafers that includes a retaining ring pressure of 11 psi, a membrane pressure of 6 psi, the platen is rotated at 31 rpm, and the wafer carrier is rotated at 33 rpm (see column 22, lines 49-54 for a description of the wafer carrier and column 27, line 65 to column 28, line 28 for a description of the polishing process). These are limitations set forth in claims 1-6 of the applicant's invention.

Regarding the less than 5 psi membrane pressure limitation of claims 3, 5, it would have been obvious at the time the invention was made to use a membrane

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pressure that is less than 5 psi, unless the applicant can show that this claimed range achieves unexpected results relative to the 6 psi example provided by Messner et al., since it has been held that the discovery of optimum values of result effective variables in known processes is ordinarily within the skill of the art [see *In re Boesch*, 205 USPQ 215 (CCPA 1980)].

Regarding the relative linear velocity range of claim 7, Messner et al. use a 20 inch diameter platen and sweep the carrier head such that the outer edge of the wafer moves from the center of the platen to the edge of the platen (see column 27, lines 65-67 and column 28, lines 21-28). This would correspond to the centerpoint of an eight inch wafer ranging 4 to 6 inches from the centerpoint of the platen. One complete rotation of the platen about the wafer centerpoint would be about 24 to 36 inches, or about 600 to 900 mm. The platen rotation speed of 31 rpms means that it takes about 2 seconds for the platen to complete a rotation about the wafer centerpoint. This corresponds to a relative linear velocity of about 300 to 450 mm per second, which is well within the applicant's claimed range.

However, Messner et al. lack the removal of conductive material from the wafer by polishing, which is a limitation of the applicant's claim 1 and, instead, in the above example polish a silicon oxide layer that has been grown on the wafer (see column 28, lines 4-7).

In their "Background" section, Messner et al. suggest that metals like tungsten, aluminum, copper, etc. can also be removed by CMP processing (see column 1, line 66 to column 2, line 4).

Therefore it would have been obvious to a person of ordinary skill in the art at the time the invention was made to modify the polishing method taught by Messner et al. in order to remove portions of deposited metal layers from a wafer surface. Messner et al. recognize that polishing is known to the semiconductor art as one way to planarize patterns of metal interconnects on a wafer surface in order to prepare it for subsequent processing steps (see column 1, lines 15-45).

19. Claims 12-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tran et al. as applied to claim 1 above, and further in view of Somekh (US 5,897,426 from applicant's IDS).

As shown above, Tran et al. anticipate claim 1 of the applicant's invention and teach a polishing process for polishing substrates comprising a silicon oxide layer and at least one metal layer that can preferably be copper with a tantalum or tantalum nitride barrier layer (see paragraph [0028]). However, Tran et al. lack the use of an abrasive-free polishing pad (the limitation of claim 12), the use of a second platen for removing the barrier layer (the limitation of claim 13), and the use of a third platen for buffing the substrate (the limitation of claim 14). Somekh teach the use of three polishing stations for sequentially polishing copper, polishing the barrier layer, and removing scratches with a soft polishing pad (see column 6, lines 41-52). The soft polishing pad can be abrasive-free (see column 5, lines 25-34).

Therefore it would have been obvious to a person of ordinary skill in the art at the time the invention was made to combine the teachings of Tran et al. and Somekh in

order to polish back copper and barrier layers formed over a silicon oxide layer and obtain a scratch-free surface. Somekh recognizes that the use of three polishing stations enables the use of different polishing pads as well as different polishing liquids for the different polishing steps (see column 6, lines 44-52).

20. Claims 29-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim et al. (US 6,113,465 from applicant's IDS) in view of Messner et al.

Referring to Fig. 7, Kim et al. disclose a polishing method for planarizing wafers that includes several segments utilizing different polishing pad speeds. For example, segment 3 has a polishing pad speed of 48 rpm, while segment 5 has a polishing pad speed of 12 rpm. For both of these segments the carrier rotation speed is fixed at 45 rpm which, for segment 5, corresponds to a ratio of carrier head rotation to polishing pad rotation of about 4:1. These are limitations set forth in claims 29, 32 of the applicant's invention.

However, Kim et al. do not expressly teach or suggest conductive material disposed on the substrate (a limitation of claim 1), the first and second relative linear velocity ranges of claim 29, the first and second relative linear velocity ranges of claim 30, the conductive material comprising copper (the limitation of claim 31), and the ratio of carrier head rotational speed to platen rotational speed falling within the range of claim 32. Regarding this ratio, it would have been obvious at the time the invention was made to use a ratio that falls within the range of claim 32, unless the applicant can show that this claimed range achieves unexpected results relative to the above example

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provided by Kim et al., since it has been held that the discovery of optimum values of result effective variables in known processes is ordinarily within the skill of the art [see *In re Boesch*, 205 USPQ 215 (CCPA 1980)].

In their "Background" section, Messner et al. suggest that metals like tungsten, aluminum, copper, etc. can also be removed by CMP processing (see column 1, line 66 to column 2, line 4). Messner et al. also teach that a 20 inch diameter platen can be used for polishing eight inch wafers (see column 27, lines 65-67 and column 28, lines 21-28) and the process of Kim et al. is applicable to eight inch wafers (see column 6, lines 25-27). It was also calculated above, based on the 20 inch platen taught by Messner et al., that the relative linear velocity corresponding to a platen speed of 30 rpm should fall within the range of 300-450 mm per second. Accordingly, the polishing pad speed corresponding to 48 rpm should fall within the range of 480-720 mm per second and that corresponding to 12 rpm should fall within the range of 120-180 mm per second. Regarding the first relative linear velocity range limitation of claim 30, it would have been obvious at the time the invention was made to increase the polishing pad speed corresponding to segment 3 to overlap the 1000 to 1200 mm per second range of claim 30, unless the applicant can show that this claimed range achieves unexpected results relative to the above example provided by Kim et al., since it has been held that the discovery of optimum values of result effective variables in known processes is ordinarily within the skill of the art [see *In re Boesch*, 205 USPQ 215 (CCPA 1980)].

Therefore it would have been obvious to a person of ordinary skill in the art at the time the invention was made to modify the polishing method taught by Kim et al. in order to remove portions of deposited copper layers from a wafer surface. Messner et al. recognize that polishing is known to the semiconductor art as one way to planarize a wafer surface in order to prepare it for subsequent processing steps (see column 1, lines 15-45). It further would have been obvious to a person of ordinary skill in the art at the time the invention was made to substitute the polishing apparatus taught by Messner et al. for that taught by Kim et al., since 20 inch diameter polishing pads are known to the art (see column 26, line 65 to column 28, line 2).

Allowable Subject Matter

21. Claims 21-23, 25-26, 28 are allowed.
22. Claims 8-11 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form to include all of the limitations of the base claim and any intervening claims and if claim 10 was rewritten or amended to overcome the objection to claim 10.
23. Claims 17-18, 20 are objected to as being dependent upon an objected to base claim.

24. Claims 15-20, 27 would be allowable if rewritten or amended to overcome the objections to claims 15-16, 19, 27 set forth in this Office action.

25. The following is a statement of reasons for the indication of allowable subject matter:

- Claim 8 would be allowable because the prior art of record does not teach or suggest a method of polishing a substrate having a conductive material formed thereon that includes the step of accelerating the platen rotational speed and the carrier head rotational speed at a rate that ranges from 5 to 30 rpms per second, in combination with the other claim limitations;
- Claims 9-11, 27 would be allowable and claims 21-23, 25-26, 28 are allowed because the prior art of record does not teach or suggest a method of polishing a substrate having a conductive material formed thereon that includes a retaining ring contact pressure that exceeds a membrane pressure by 0.4 psi and also has a ratio of retaining ring contact pressure to membrane pressure of more than 1.1, combined with a second platen rotational speed that is less than a first platen rotational speed, and in combination with the other claim limitations; and
- Claims 15-20 would be allowable because the prior art of record does not teach or suggest a method of polishing a substrate having a conductive material formed thereon that includes a retaining ring contact pressure that exceeds a membrane pressure by 0.4 psi and also has a ratio of retaining ring contact

pressure to membrane pressure of more than 1.1, combined with a first linear relative velocity that is more than 600 mm per second and a second linear relative linear velocity that is less than 600 mm per second, and in combination with the other claim limitations.

Conclusion

26. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Tsuchiya et al. teach a CMP method that utilizes different relative speeds. Jin et al., Li et al., and Mandigo et al. teach CMP methods for planarizing metal layers.

27. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Stephen W. Smoot whose telephone number is 703-305-0168. The examiner can normally be reached on M-F (8:00am to 4:30pm).


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr. can be reached on 703-308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

SWS

March 7, 2003


CARL WHITEHEAD, JR.
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800